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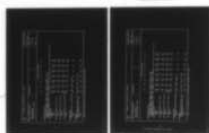
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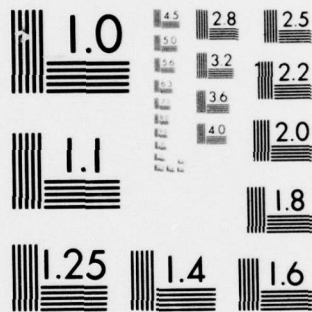
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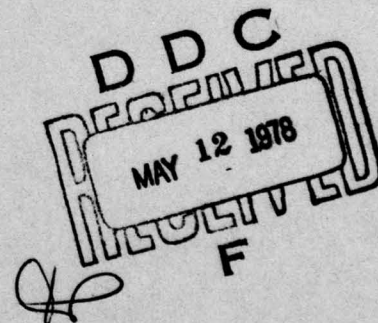


USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 103

F-5E In-Flight Crew Noise

OCTOBER 1976



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AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
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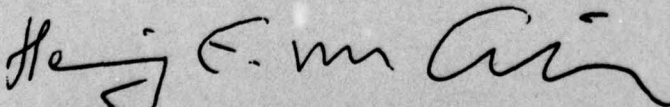
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FOR THE COMMANDER



HENNING E. VON GIERKE

Director

Biodynamics and Bioengineering Division
Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The F-5E is a USAF light tactical fighter. This report provides measured data defining the bioacoustic environments at the pilot's location inside this aircraft during normal flight operations. Data are reported for one location in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for total daily exposure of personnel with and without standard Air Force ear		

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protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol. 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 72310418, Measurement of Noise and Vibration Environments of Air Force Operations.

The author acknowledges the efforts of John N. Cole who established the data analysis requirements and assisted in the preparation of this report, and Henry Mohlman and David Eilerman of the University of Dayton who assisted in the mechanics of data processing.

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INTRODUCTION

The F-5E is a single-seat light tactical fighter manufactured by the Northrop Corporation. Power is provided by two GE J85-GE-21 turbojet engines each rated at 5000 lb maximum takeoff thrust with afterburner. The engines are manufactured by the General Electric Company, Aircraft Engine Group, Military Engine Division.

This volume provides measured data defining bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the F-5E aircraft.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type noise data in the handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. *Refer to Volume 1* (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and are available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of each updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433; Autovon 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

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1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board an F-5E aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard F-5E environments but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Measurements were made inside the cockpit at the pilot's location with MICROPAK, which is a small in-flight recording system worn by the pilot. The miniature electret condenser microphone was attached to the pilot's helmet on a light-weight boom and positioned at ear level 0.1 meter from the helmet's surface with its diaphragm parallel to the surface pointing away from the helmet.

In the analysis, microphone corrections for random incidence were applied to the overall system's response. The recorded samples were analyzed using a 4- or 8-second integration time to obtain power-averaged levels that effectively smooth out short duration fluctuations and best describes the exposure.

Table 1 lists the measurement location and test conditions as numeric/ alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the F-5E aircraft at the specified location. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1
MEASUREMENT LOCATION AND TEST CONDITIONS

F-5E, Edwards AFB, 16 April 76

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Cockpit	Seated Head Level
CONDITION	DESCRIPTION	
A	Left Engine Start — Canopy Open	
B	Idle — Both Engines — Canopy Closed	
C	Ground Runup — 80% RPM — Canopy Closed	
D	Takeoff — Max. Power	
E	Climb to 5000' MSL — Mil Power	
F	Climb to 10,000' MSL — Mil Power	
G	Climb to 15,000' MSL — Mil Power	
H	Firing Range Sweep — 15,000' MSL	
I	Climb to 20,000' MSL — Mil Power	
J	Cruise 375 KIAS — 20,000' MSL	
K	Cruise — 380 KIAS — 21,100' MSL	
L	Descent With Missile Firing	
M	Final Approach — Flaps Down	
N	Touch Down and Landing Roll	
P	Taxi	

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:	
1/3 OCTAVE BAND											
2										OMEGA 3.2	
										TEST 76-406-001	
NOISE SOURCE/SUBJECT:										RUN 01	
(OPERATION:											
(
F-5E AIRCRAFT										13 SEP 76	
(
INFLIGHT NOISE LEVELS										PAGE F1	
(
LOCATION/CONDITION											
FREQ (HZ)	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H			
50	93	94	81	86	80	80	80	80	80		
63	90	88	81	89	80	80	80	80	80		
80	88	86	83	98	83	83	83	83	83		
100	87	87	95	100	95	96	95	95	96		
125	85	85	98	101	96	98	98	98	98		
160	85	84	93	95	92	94	94	94	94		
200	83	85	93	94	93	94	94	94	95		
250	82	85	93	94	93	94	93	93	96		
315	84	85	94	92	93	92	92	92	94		
400	87	86	93	92	93	93	93	93	94		
500	82	84	98	98	98	98	97	98	98		
630	82	84	92	91	91	93	92	93	93		
800	80	85	100	89	91	92	93	92	93		
1000	78	86	95	89	89	90	90	92	92		
1250	80	85	91	89	89	92	91	92	92		
1600	80	88	89	88	88	91	91	91	92		
2000	79	87	88	86	88	92	91	91	92		
2500	79	86	89	88	87	91	91	91	92		
3150	81	89	89	88	88	91	91	91	91		
4000	84	92	92	92	91	92	92	92	93		
5000	82	86	87	86	85	88	88	88	88		
6300	85	89	89	89	86	88	89	88	88		
8000	95	86	89	88	86	89	89	89	89		
10000	97	85	89	87	87	91	92	91	91		
OVERALL	102	101	107	108	105	106	106	106	107		
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.											

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION:	
2	OCTAVE BAND		
NOISE SOURCE/SUBJECT:		OMEGA 3.2	
F-5E AIRCRAFT		TEST 76-406-001	
INFLIGHT NOISE LEVELS		RUN 01	
		13 SEP 76	
		PAGE J1	

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)									
OCTAVE BAND									
2									
NOISE SOURCE/SUBJECT: (OPERATION:)									
F-5E AIRCRAFT									
INFLIGHT NOISE LEVELS									
LOCATION/CONDITION									
FREQ (HZ)	1/I	1/J	1/K	1/L	1/M	1/N	1/P	IDENTIFICATION:	
63	85	84	85	86	85	90	92	OMEGA 3.2	
125	101	98	99	99	100	97	95	TEST 76-406-001	
250	99	95	97	99	98	96	86	RUN 02	
500	100	98	99	102	100	90	87	13 SEP 76	
1000	97	94	96	99	96	82	78	PAGE J2	
2000	96	94	96	96	96	80	75		
4000	96	94	94	95	96	79	75		
8000	95	93	93	93	95	78	78		
OVERALL	107	104	105	107	106	101	98		

TABLE: MEASURES OF HUMAN NOISE EXPOSURE		IDENTIFICATION:	
3		OMEGA 3.2	
NOISE SOURCE/SUBJECT: (OPERATION:)		TEST 76-406-001	
F-5E AIRCRAFT ()		RUN 02	
INFLIGHT NOISE LEVELS ()		13 SEP 76	
()		PAGE H2	
HAZARD/PROTECTION		LOCATION/CONDITION	
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR			
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR			
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)			
NO PROTECTION			
OASLC	106 104 105 107 106 100 97		
OASLA	104 102 103 105 104 92 87		
T	15 21 18 13 15 120 285		
HGU-2A/P HELMET WITH H-154			
OASLA*	93 90 91 93 92 88 82		
T	101 170 143 101 120 240 679		
HGU-2A/P HELMET WITH H-154(A)			
OASLA*	88 85 86 89 87 84 78		
T	240 404 339 202 285 480 960		
HGU-2A/P HELMET WITH CUSTOM LINER			
OASLA*	98 95 97 100 97 90 84		
T	42 71 50 30 50 170 480		
COMMUNICATION			
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)	98 90 97 99 97 84 80		
PSIL			
ANNOYANCE			
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)			
TONE CORRECTION (C IN DB)	119 117 118 119 120 107 103		
PNLT			
C	1 2 1 1 2 1 1		

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE									
3									
IDENTIFICATION:									
OMEGA 3.2									
TEST 76-406-001									
RUN 01									
NOISE SOURCE/SUBJECT:									
(OPERATION:									
F-5E AIRCRAFT									
(
INFLIGHT NOISE LEVELS									
(
(
(
(
PAGE H1									
LOCATION/CONDITION									
1/A 1/B 1/C 1/D 1/E 1/F 1/G 1/H									
HAZARD/PROTECTION									
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR									
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR									
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)									
NO PROTECTION									
OASLC									
OASLA									
T									
HGU-2A/P HELMET WITH H-154									
OASLA*									
T									
HGU-2A/P HELMET WITH H-154(A)									
OASLA*									
T									
HGU-2A/P HELMET WITH CUSTOM LINER									
OASLA*									
T									
COMMUNICATION									
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)									
PSIL									
ANNOYANCE									
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PND8)									
TONE CORRECTION (C IN DB)									
PNLT									
C									
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.									